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Full Length Research Paper

Determinants of long lasting insecticidal nets distribution, ownership and use in the Federal Capital Territory, Nigeria – implications for malaria programmes

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A community-based household survey was conducted to investigate the ownership and utilization of malaria control commodities in the Federal Capital Territory (FCT), Nigeria, using a multifaceted four-phase operational research. The main objectives were to investigate access to and utilization of health services in the capital of the country, to evaluate Insecticide-treated nets (ITN)/long lasting insecticidal nets (LLIN) household coverage including ownership and usage and to assess progress towards achieving LLIN target in the FCT. A multifaceted four-phase operational research, consisting of a community-based household survey describing ownership and use of LLINs, a review of hospital records on malaria disease, the prevalence of malaria among children under the age of five years and use of sulphadoxine-pyrimethamine as intermittent preventive treatment in pregnancy (IPTp), was used to investigate the extent of access to health services and utilization of malaria control strategies adopted in the FCT with reference to the Roll Back Malaria initiative. Of the 585 households surveyed, only 158 (27%) reported ownership of LLINs and 427 (73%) not owning LLIN ($\chi^2 = 3.83$, $p < 0.05$). Only 2% of adults, 7% under-fives and 19% of pregnant women, respectively slept under LLINs the night before survey. Urban under-fives were 12 times more likely to seek treatment for malaria than their semi-urban counterparts ($\chi^2 = 13.2$, $p = 0.0002$, OR = 12.3, CI = 2.47, 61.35). There was no significant difference in the proportion of women in urban, semi-urban and rural location, who took antimalaria medication during last pregnancy or those who did not. Information, education and communication targeting health promotion on the use of LLIN in FCT could have a salutary impact on the well-being of rural, semi-urban and urban dwellers in Federal Capital Territory, Abuja, Nigeria.

Key words: Community, household, malaria, long lasting insecticidal nets, Federal Capital Territory, area councils, economic burden, gross domestic product.

INTRODUCTION

During the past decade, increased ownership and utilization of protective commodities against malaria,

an infectious disease, such as conventional nets, any mosquito nets (AMNs), insecticide treated mosquito nets (ITNs) and long lasting Insecticide-treated Nets (LLINs) within the household (Hill et al., 2006; Lengeler, 2004; Kulkarni et al., 2010) have contributed significantly to more attention, in terms of coverage with interventions being paid to malaria among the vulnerable groups-children under the age of five and pregnant women (Webster et al., 2005). In the same vein, indoor residual spraying (IRS) (Teklehaimanot et al., 2009; Kim et al., 2012) and artemisininin-based-combination therapies (ACTs) in the health facilities (Roll Back Malaria, 2011; Otten et al., 2009) are expected to bring added value to the entire population in malaria endemic regions in what is referred to as universal coverage (World Health Organization (WHO), 2005; UN Secretary General, 2008). Not surprisingly, during the same period, decrease in malaria morbidity and mortality patterns has been recorded in sub-Saharan Africa (Roll Back Malaria, 2011; Eisele et al., 2009; Eisele et al., 2010; Komatsu et al., 2010), and malaria-related conditions in under-fives, such as episodes of fever, have reduced considerably (Lengeler, 2004).

World Health Organization and many authors have emphasized that annually, an estimated 300 to 500 million new infections and 1 to 3 million deaths result from malaria, and that more than 90% of these cases occur in sub-Saharan Africa, mostly among the poorest without access to health facilities (Webster et al., 2005; WHO, 2011; Ogunremi, 2009; Rowe et al., 2006). An estimated 3.3 billion people were at risk of malaria in 2010 among whom, 2.1 billion were at low risk (< 1 reported case per 1000 population), 94% of who were living in geographic regions other than the WHO African region. The 1.2 billion at high risk (≥ 1 case per 1000 population) were living mostly in the WHO African region (47%) and South-East Asia region (37%) (WHO, 2011). There were an estimated 216 million episodes of malaria in 2010, with a wide uncertainty interval (5th to 95th centiles) from 149 million to 274 million cases. Approximately 81%, or 174 million (113 to 239 million) cases, were in the African region, with the South-East Asian region accounting for another 13%. There were an estimated 655,000 (537,000 to 907,000) malaria deaths in 2010, of which 91% (596,000; range = 468,000 to 837,000) were in the African region. Approximately 86% of malaria deaths globally were of children under five years of age (WHO, 2011).

Despite all efforts, malaria, a disease caused by plasmodium-carrying female Anopheles mosquitoes, remains one of the major causes of morbidity and mortality in Nigeria, with diverse consequences and complications (Okiro et al., 2007). The disease is still the number-one killer of children in many African countries, though the deaths of thousands of children under five years old annually could be prevented by simple cost-effective measures including consistent use of long-lasting insecticide treated mosquito nets by families and anti-malaria treatment for pregnant women (UNICEF, 2007). Still, malaria remains a key public health dilemma for most countries, including Nigeria, where an estimated 300,000 children die of the disease each year, and up to 11% of maternal mortality is caused by it, which represents one in every four deaths of children and one in ten deaths of pregnant women (Federal Ministry of Health/National Malaria Control Program (FMOH/NMCP), 2001, 2010, 2009 to 2013). It is estimated that about half the population of Nigerian adults suffer from at least one episode of malaria annually, that children under five years have as many as three or four episodes every year, and that nearly 110 million cases of malaria are clinically diagnosed annually, accounting for 60% of outpatient visits and 30% of hospitalizations (Komatsu, 2010).

Available evidence suggests that in addition to its direct health impact, malaria imposes a heavy social and economic burden on Nigerians, amounting to a loss of about US $55 billion per annum, or 12.0% of gross domestic product (Jimoh et al., 2007). The country positioned its National Malaria Control Programme and the contributions of some of its Roll Back Malaria partners namely: WHO, United Nations International Children's Education Fund (UNICEF), World Bank, United States Agency for International Development (USAID) etc to shrink the malaria burden by half by the end of 2010 (FMOH/NMCP, 2009 to 2013), a point in time now shifted to 2015. Of its many strategies, one is to distribute 63 million long-lasting insecticide treated mosquito nets (LLINs), to 32 million households in all 36 states and the Federal Capital Territory (FCT). The campaign is the largest envisaged distribution of LLINs in the world.

About 10 million LLINs were distributed by the National Malaria Control Programme through several channels such as the campaign distribution, Immunization Plus Days (IPDs) and through routine distribution at ante-natal clinics in some parts of Nigeria between 2000 and 2007. This was achieved in collaboration with other implementing partners and some private not-for-profit organizations. For example, from April, 2002 to September, 2009, NetMark, an International NGO supported by USAID, was active in some parts of Nigeria. In partnership with three local NGOs- Malaria Parasite: Africa Fights Back, Delybimb Malaria Foundation, and WomanKind Organization-NetMark conducted free ITN distribution activities in rural communities in Kano, Benue, Abia,

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Bauchi, Lagos, Cross River, the Federal Capital Territory Abuja, and Nasarawa States, totaling 305,000 ITNs (AED, n.d.). In Cross River State, NetMark successfully distributed 673,000 LLINs donated by USAID and the Canadian government, in collaboration with State and 18 Local Government Authorities (LGAs) during the integrated measles campaign. Laudable as the operations of NetMark were, the total number of LLINs distributed in FCT by this organization, the exact time of the distribution of the LLINs and the geographical location of the beneficiaries of these LLINs are not yet accessible, at least not through NetMark"s report.

It is therefore necessary to review the ownership and use of LLINs in the FCT to ascertain gaps and to fill the identified gaps with government approved malaria control strategies. Some studies on LLIN ownership and use also took place in Nigeria around this time. Ogunremi (2009) reviewed the etiology of malaria, methods of prevention focusing on the compliance to the use of ITNs as a method of prevention in the cities of Ilorin, Kwara state, Zaria in Kaduna state and Abuja and in the FCT in Nigeria. However, the sample size of 240 in all these cities with a combined population of over three million may not have captured the variations in characteristics in the different survey areas and does not give a strong statistical data to draw conclusion on household use of LLINs in those areas. Another study differentiated use and non-use of LLINs between the northern Sahel Savannah and the southern Niger Delta areas of Nigeria and found higher use of LLINs in the southern states than in the northern states (Afolabi et al., 2009). It is imperative that malaria control programmes in Sahel Savannah Areas (SSA) continue to supply LLINs and ensure the use of this commodity for universal coverage and protection (Ahmed and Zerihun, 2010).

There is a lacuna of information on the use of malaria control commodities in the six Area Councils of the Federal Capital Territory of Abuja. Therefore, the objectives of this survey are: (i) To investigate access to and utilization of health services in reference to assess, distribution, ownership and utilization of LLINs among under-fives and among pregnant women by geographical locations at the FCT; (ii) to compare the ownership and use of LLINs in the six Area Councils of the FCT; (iii) to determine the proportion of children below the age of five years and currently pregnant women who slept under LLINs night before survey and (iv) to determine the treatment seeking behavior of children under five years of age living in FCT, Nigeria.

This study assumes the null hypothesis that: (i) There is no significant difference in the proportion of households with LLINs and those without LLINs; (ii) use of LLINs among children less than five years of age is not significantly different since the commencement of Roll Back Malaria (RBM) in FCT; (iii) use of LLINs among pregnant women is not significantly different since the commencement of RBM in FCT and (iv) distribution of LLINs is not significantly different by Area Councils, that is, no Area Council is favored above the others in LLINs distribution. The epistemological standpoint of this survey is based on the fact that information regarding utilization of health services is best gathered by quantitative analysis because commodities were distributed quantitatively and recorded as such. Household that used or did not use these commodities are also in numbers that can be aggregated or disaggregated.

MATERIALS AND METHODS

This study was conducted in FCT, a malaria endemic area in North-central Nigeria. This location is where the Abuja Declaration on Roll Back Malaria by African Heads of State took place in April, 2000 and where they committed national governments and their development partners to the goal of increasing coverage with ITNs to 60% of target groups by 2005 (WHO, 2000). In 2004, the level of coverage was adjusted to 80% after monitoring the effects of ITNs on various communities in Nigeria (Abebe et al., 2003). The FCT, where Abuja, the capital city of Nigeria is located, was carved out of three states namely: Nasarawa, Niger and Kogi, in 1976. The territory lies just north of the confluence of the Niger and Benue rivers, bordered by the states of Niger to the West and North, Kaduna to the northeast, Nasarawa to the east and south, and Kogi to the southwest. The FCT has a landmass of approximately 7,315 km², of which Abuja city occupies 275.3 km^2. It is situated within the Savannah region with moderate climatic conditions. Geographically, Abuja is located in the central region of the country, between latitude 8.25 and 9.20 North of the equator and longitude 6.45 and 7.39 East of Greenwich Meridian (National Population Census (NPC), 2005). The FCT is divided into six Area Councils (ACs) because it is not a state but a territory whereas each of the other 36 states in the country is divided into Local Government Areas (LGAs).

Survey site

The six ACs where this study was conducted are Abuja Municipal Area (AMAC), an urban settlement, Gwagwalada, Kuje and Bwari which are semi urban and Abaji and Kwali which are rural areas. Unlike the States of Nigeria which are headed by elected Governor, FCT is administered by the Federal Capital Territory Administration headed by a minister appointed by the President, through the Senate House.

Survey timing

This was a cross-sectional household survey which was conducted between October, 2009 and March, 2010, at the peak of the second rainy season and close to the beginning of the first rainy season. The Federal Ministry of Health (FMOH), through the National Malaria Control Programme (NMCP), Yakubu Gowon Centre (YGC), Millennium Development Goal (MDG), Office of the Federal Capital Territory and UNICEF distributed close to 300,000 LLINs between 2007 and 2009 prior to this survey. Between March to May, 2011, another 524,127 LLINs were distributed by NMCP and

partners such as World Bank, JSI/USAID and Yakubu Gowon Centre in FCT. Therefore, this study serves as an indicator of prior density for access, ownership and use of LLINs and other malaria control commodities in various settings within the FCT in Nigeria.

Study design

To assess household ownership and usage of LLINs and lay the foundation for future distribution of this malaria commodity in the FCT, a survey was conducted about 12 months before the LLIN mass campaign astride the dry and wet seasons. Three cross-sectional surveys were conducted at roughly two months interval using a pre-tested interviewer-administered questionnaire. The community-based interview, using pre-adapted WHO-developed questionnaires, was conducted to randomly-selected household heads (HH) or their representatives when the HH was absent. The main outcome used for the sample-size calculations is the number of children below five years of age that slept under an LLIN the night before the survey. Set at a power of 90%, the survey intended to estimate LLIN usage by these under-fives within an error range of 5%. A response rate of 90% was assumed, a design effect of two and that 60% of the participating households have at least one child that is below the age of five.

Sample size determination

The survey used simple random sampling to determine households to be included in the study. To achieve a 3% precision (level of error) with 95% confidence level, assumed proportion of 0.5 and presumed desire change of 20%, a sample size of 535 households was required for meaningful analysis. This was rounded up to 585 households giving a 10% allowance for non-response rate.

Definitions

For the purpose of this survey, household is defined as “all persons who eat out of the same food bowl (or pot or earthenware) and these persons recognize the same head of household.” Coverage is defined as “the proportion of households possessing at least one LLIN”. Usage is defined as “the proportion of children that were reported to have slept under an LLIN the previous night”. Children under the age of five years were defined as “children aged 0 to 59 months at the time of the campaign”.

Data analysis

Data was entered into statistical package for social science (SPSS) version 17. These data were cleaned and both descriptive and categorical analyses were carried out to assess associations between ownership and usage of malaria control commodities, especially LLINs, in urban, semi-urban and rural settings in the survey area. A chi square test was used to describe differences in proportions. Statistical significance was set at $P < 0.05$.

Ethical clearance

The survey was conducted with the understanding and informed consent of all respondents and caregivers. The survey was approved by the FCT Department of Health, Abuja, Nigeria. The procedures followed were in accordance with the ethical standards of the committee on human experimentation and in accordance with the Helsinki Declaration.

RESULTS

This household survey was carried out to investigate access to and utilization of health services in reference to distribution, ownership and utilization of LLIN among under-fives and among pregnant women by geographical locations in the six Area Councils of the FCT, Nigeria (Figure 1). The six ACs were geographically identified as urban settlement (Abuja Municipal Area Council [AMAC]), semi-urban settlements (Kuje, Bwari and Gwagwalada [G/lada]) and rural settlements (Abaji and Kwali). The total population of these ACs was 1, 378,931 (NPC, 2005) among whom 2,020 adults and 600 children below the age of 5 years were included in this survey. This figure comprises 1,073 (40.95%) adult males, 947 (36.15%) adult females, 322 (12.3%) under-five males and 279 (10.7%) under-five females, respectively. The 22.9% of under-fives in this survey corresponds to that age group in the population pyramid of the country (NPC, 2005). There were more female respondents between the ages of 16 to 30 years, otherwise, respondents in all other age groups were male dominated (Figure 2). A total of 585 households consented to participate in the survey, with a refusal rate of 2.5%. In all, there were only 158 (27%) households with LLINs in all these ACs, ranging from 19% ownership in the urban settlement (AMAC) to 42% in rural Abaji (Figure 3). Rural settlements were twice more likely to own LLIN compared to urban settlement ($\chi^2 = 5.69$, $p = 0.02$, OR = 2.02, CI = 1.13, 3.62), thereby rejecting the null hypothesis. The average net ownership was less than one net per household. Abaji had the highest average number of 0.4 LLINs per household (Table 1). The Table also indicates that urban settlement has the lowest average number of LLINs/household (0.2) as compared to semi-urban (0.3) and rural (0.3) settlements. The average number of persons per household was 4.5, being highest in the urban settlement (5.3) and lowest in the rural settlement (4.1).

Conversely, the total number of households with LLINs was lowest (19, 19%) where household population was relatively high, and highest (42, 42%) where household population is relatively low. This pattern is also reflected in the proportion of households that own 1, 2 or more than 2 LLINs (Figure 4). Thus, there was a significant difference ($\chi^2 = 3.84$; df = 1, $P < 0.05$) in the proportion of households with at least one LLIN (158, 27.0%) and those without LLIN (427, 73.0%) in all the ACs. Detailed illustrations of the population of survey (Table 2 and Figure 2) reflect gender differentiation among adults

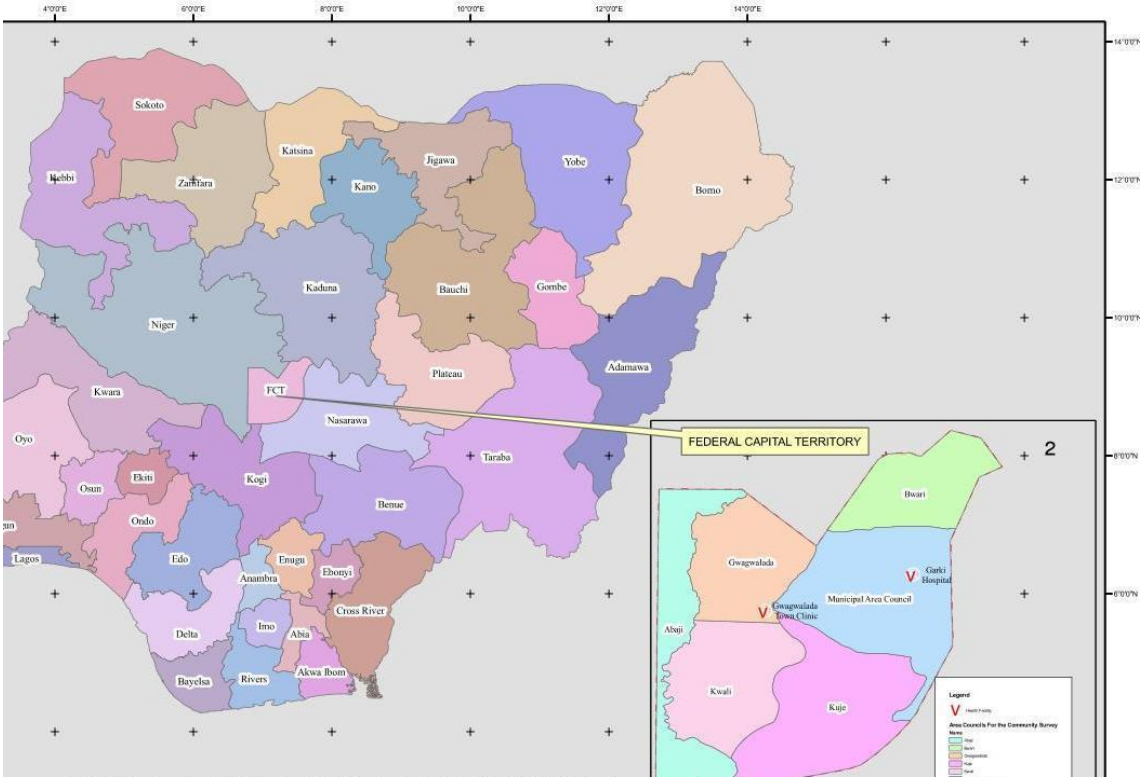

Figure 1. Composite map of Federal Capital Territory (FCT) within Nigeria showing the six Area Councils.

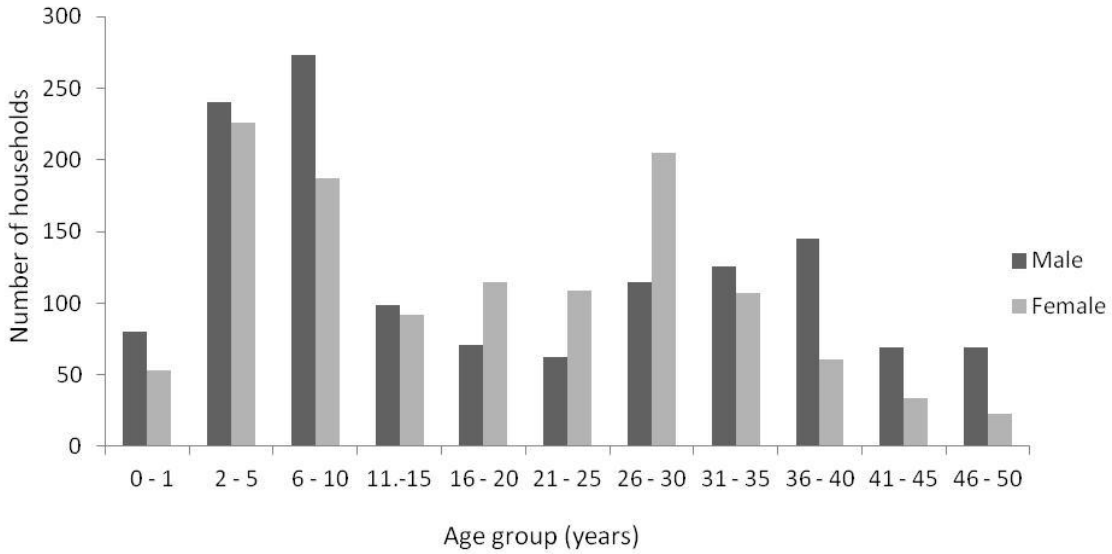

Figure 2. Distribution of age-groups and sex in surveyed households.

(1,073, 53.1% males; 947, 46.9% females) and among the under-fives. Among the 341 women aged 15 to 49 years surveyed in the six ACs, 120 were currently pregnant. Also, there were 600 children less than five

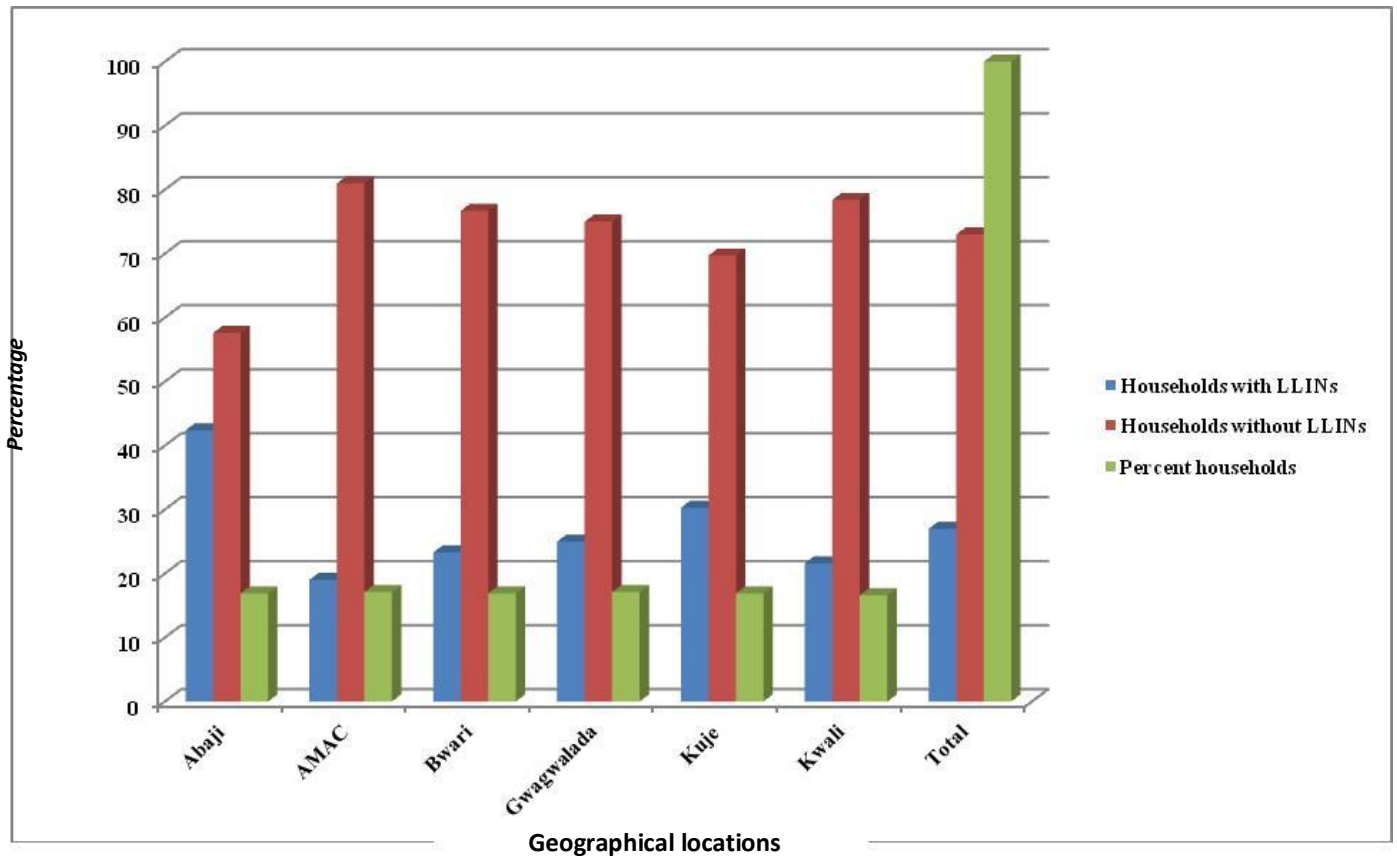

Figure 3. Distribution of households with and without Long Lasting Insecticidal Nets (LLINs) by geographical location in the Federal Capital Territory.

years of age in the survey among whom were 496 respondents distributed unevenly in urban, semi-urban and rural settings. Under-fives participation in this household survey was skewed more to the rural (χ^2 = 14.77, p = 0.0001, OR = 2.86, CI = 1.66, 4.97) and semi-urban (χ^2 = 16.32, p = 0.00005, OR = 2.91, CI = 1.71, 4.96) dwellers who were almost thrice as likely to participate in the survey compared to urban under-fives (Table 3).

The distribution of under-fives and pregnant women who slept or did not sleep under LLINs night before the survey according to geographical location is illustrated in Table 4. Overall, only 33 (7.6%) of surveyed under-fives and only 23 (19.2%) of surveyed pregnant women slept under LLINs the night before survey. To further stress this, no under-five and no pregnant respondent in urban location slept under an LLIN the night before the survey whereas 19 (8.3%) and 14 (7.2%) under-fives in semi-urban and rural locations as well as 15 (30.0%) and 8 (20.5%) of pregnant women in semi-urban and rural areas, respectively slept under an LLIN night before the survey. A significant proportion of semi-urban (χ^2 = 6.56, p = 0.01) and rural (χ^2 = 5.61, p = 0.02) under-fives, respectively slept under LLIN night before survey compared to urban under-fives. This trend is also seen among pregnant women in the urban, semi-urban and rural areas of FCT, where overall, only 19.2% of this group of people slept under LLIN the night before survey, leaving a large proportion of them (97, 80.8%) unprotected from malaria attack. However, LLIN use among pregnant women was higher in the semi-urban area (12, 30.0%) compared to urban (0.0%) or rural (20.5%) areas.

Figure 5 illustrates probable wrong use to which LLIN or any net is put in some communities. Not sleeping under LLIN is probably reflected in the treatment seeking behavior of children as shown in Table 5 where, among 168 under-fives with fever two weeks before the survey, 156 (92.85%) sought medical attention from health facilities. Urban under-fives were more than 12 times likely to seek treatment for malaria than their semi-urban counterparts (χ^2 = 13.2, p = 0.0002, OR = 12.3, CI = 2.47, 61.35) while semi-urban under-fives were about 27 times more likely to seek help for fever presumed to be of malaria origin compared to rural under-fives (χ^2 = 17.8, p = 0.00003, OR = 27.4, CI = 3.36, 1216.98). Interestingly, there was no significant difference in the proportion of urban under-fives that sought treatment for malaria when

Table 1. Surveyed households with LLIN ownership according to geographical location of area council: urban, semi-urban, rural.

Parameter	Urban	Semi-urban			Rural		Total
	AMAC	Kuje	Bwari	G/lada	Abaji	Kwali	
Total population	871,596	119,583	61,844	180,497	46,407	99,004	1,378,931
Total No. of HH surveyed	100	99	90	100	99	97	585
Total No. of adults in survey	402	411	247	332	267	361	2020
Total No. of U5s in survey	123	109	72	122	71	103	600
Av. No. of persons per HH	5.3	5.3	3.5	4.5	3.4	4.7	4.5
Av. No. of persons per location	5.3		4.8		4.1		
Total No. of HH with LLINs	19	30	21	25	42	21	158
Total No. of HH without LLINs	81	69	69	75	57	76	427
χ^2	2.14		1.95		5.69		-
P	0.14		0.16		0.02		-
OR	1.52		1.33		2.02		-
CI	0.87, 2.67		0.89, 1.98		1.13, 3.62		-
Av. No. of LLINs per HH	0.2	0.3	0.2	0.3	0.4	0.2	0.3
Av. No. of LLINs per HH/location	0.2		0.3		0.3		
No. (%) HH owning 1 LLIN	15 (15)	21 (21)	16 (18)	23 (23)	33 (33)	17 (18)	125 (21)
No. (%) HH owning 2 LLINs	4 (4)	9 (9)	5 (6)	2 (2)	8 (8)	3 (3)	31 (5)
No. (%) HH owning >2 LLINs	0 (0)	0 (0)	0 (0)	0 (0)	1 (2)	1 (5)	2 (1)

Av = average, OR = odd ratio, CI = confidence interval, No. = number

compared to rural under-fives (χ^2 = 0.43, p = 0.51, OR = 0.45, CI = 0.008, 8.89).

A total of 341 (75, 22.0% urban; 156, 45.7% semi-urban and 110, 32.3% rural) women of reproductive age were interviewed for their use or non-use of antimalarial during last pregnancy. Among these, 220 (64.5%) claimed they took antimalarial during last pregnancy, 67 (19.7%) claimed they did not and 54 (15.8%) claimed did not know whether they took antimalarial or not (Table 6). Between 2007 and 2009, a total of 296,556 LLINs have been distributed in FCT (Table 7). There was no significant difference in the proportion of women in urban, semi-urban and rural location that took or did not take antimalarials during last pregnancy.

DISCUSSION

It is now clear that there is on-going reduction in child mortality, with some African countries reporting less than 76 deaths of children under five per 1,000 births (Roll Back Malaria, 2011), indicating significant advances in the fight against the malaria disease in sub-Saharan Africa. According to the reported information, the advance in the fight against malaria is due largely to the mass distribution of treated mosquito nets, especially the LLINs, to pregnant women. This study documents the unexpected situation of malaria control commodities and/or programmes not getting to target populations or communities. There are still various communities in sub-Saharan Africa (SSA) where children and pregnant women cannot access appropriate health services such as malaria control programmes.

Malaria infection in pregnancy can lead to devastating consequences for both mother and child. The World Health Organization's recommended policy for malaria prevention and control is a package of intermittent preventive treatment (IPTp) and insecticide treated nets (WHO, 2004). These interventions have the potential to substantially reduce the disease burden and adverse out-comes of malaria in pregnancy. The strategic approaches to malaria control fall into two major categories – prevention and case management. Taken together, these strategies work against both the transmission of the

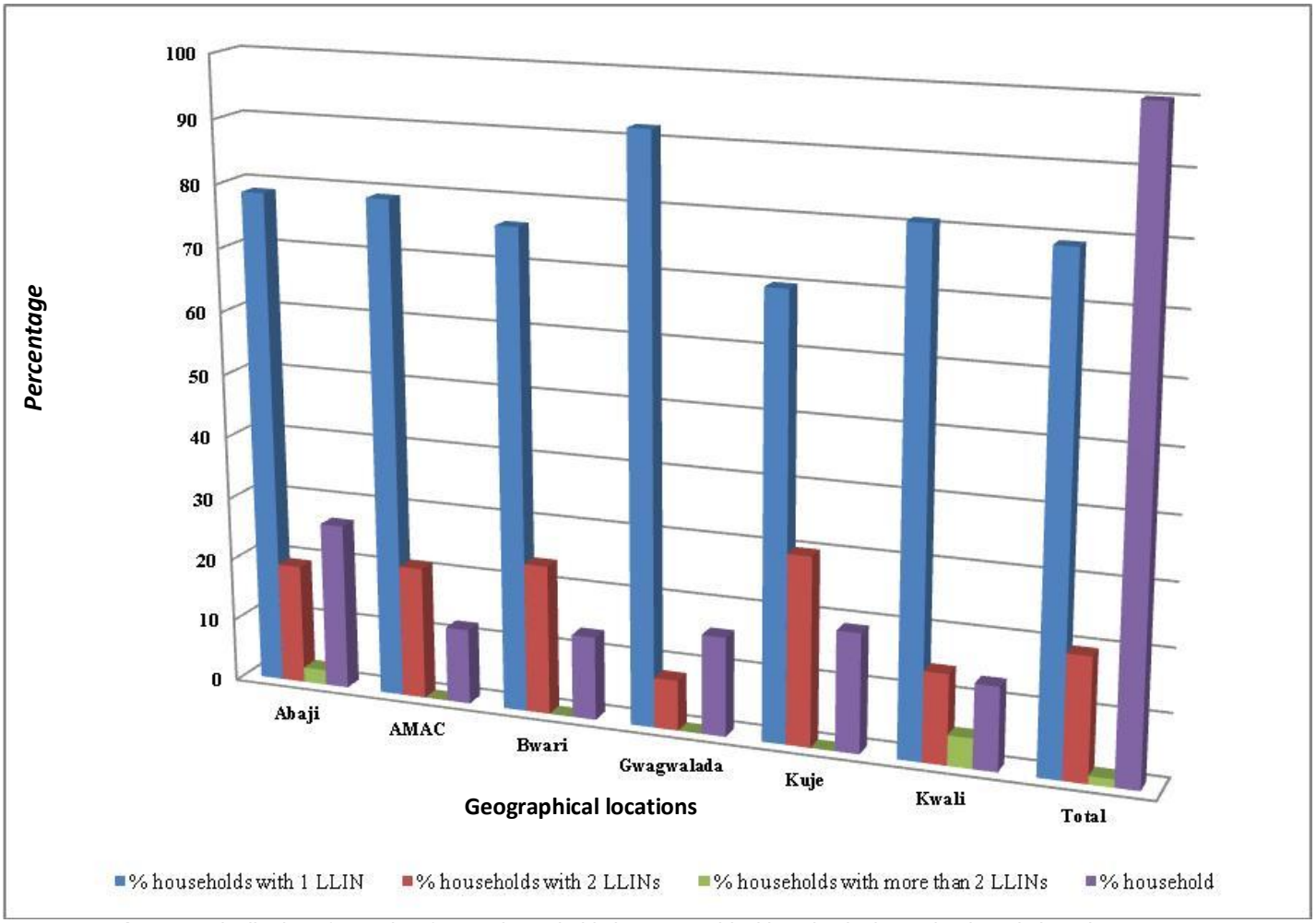

Figure 4. Distribution of quantity of LLINs households by geographical location in the Federal Capital Territory.

parasites from mosquito vector to humans and from humans to mosquitoes and the development of illness and severe disease in humans (WHO, 2010). Because high coverage rates are needed to realize the full potential of protective agents such as LLINs, WHO recommended that all people at risk in areas targeted for malaria prevention should be covered with LLINs, that is, "universal coverage" (WHO, 2007i, ii).

Evidence abounds that increase coverage of LLIN in target areas enhances protection of vulnerable groups and protects all community members (Kulkarni, 2010; Nevill et al., 1996). The drive to achieve universal coverage of LLINs does not contradict the fact that pregnant women are still a more vulnerable group that needs to be protected from anemia and death themselves and miscarriage, low birth weight and greater infant and child mortality for their offspring (Roll Back Malaria, 2011). So far, the data on net coverage for pregnant women is not encouraging, as indicated in this study and other studies (Ahmed and Zerihun, 2010; Thwing et al., 2008). LLIN is of exceptional imperative because this commodity is about the only safe non-invasive malaria control intervention that women can use as from the time they enter the reproductive age group and throughout pregnancy.

In line with our results, a study found that 45 of 47 SSA countries had an ITN policy for pregnant women and that estimated coverage was 17% among the nearly 28 million pregnancies at risk of malaria in the 32 countries with information (http://www.sciencedaily.com/releases/2011/01/110126081653.htm, n.d.). Furthermore, among 39 countries with an IPTp policy, 25% of pregnant women had received some IPTp, despite 77% visiting an antenatal clinic (ANC), the main delivery channel for reaching pregnant women with ITNs and IPTp (http://www.sciencedaily.com/releases/2011/01/110126081653.htm n.d.).

Table 2. Proportion of adults, currently pregnant women and children under five years old in the survey by Area Council.

Area Council	Adults		Total No. of pregnant women	Women 15-49 yrs old				Children under 5 years o	
	Male frequency (%)	Female frequency (%)		No. in survey frequency (%)	Currently pregnant frequency (%)	Total	No. In survey	No. of respondents	frequ
Abaji	216 (20.1)	186 (19.6)	2,320	32 (9.4)	17 (7.0)	9,281	123	95	62
AMAC	218 (20.3)	193 (20.4)	43,580	75 (22.0)	31 (13.0)	174,319	109	74	56
Bwari	131 (12.2)	116 (12.2)	8,092	36(10.6)	15 (10.0)	32,369	72	60	3
G/lada	160 (14.9)	172 (18.2)	9,025	77 (22.6)	12 (5.0)	36,099	122	106	68
Kuje	143 (13.3)	124 (13.1)	5,979	43 (12.6)	23 (15.0)	23,917	71	62	39
Kwali	205 (19.1)	156 (16.5)	4,950	78 (22.9)	22 (11.0)	19,801	103	99	65
Total	1,073 (53.1)	947 (46.9)	73,946	341 (100.0)	120(100.0)	296,786	600	496	32

Table 3. Chi-square relationship between under-five respondents and non-respondent in the survey.

Location	Children under 5 years of age			χ^2	P	OR	CI
	No. in survey	Respondents	Non-respondents				
Urban	109	74	35	16.3	0.00005	2.9	1.7, 5.0
Semi-urban	265	228	37				
Urban	109	74	35	14.8	0.0001	2.9	1.7, 5.0
Rural	226	194	32				
Semi-urban	265	228	37	0.004	1.0	1.0	0.6, 1.6
Rural	226	194	32				

Methods to protect pregnant women from malaria are still underutilized in SSA (KEMRI-Wellcome Trust Research Programme, n.d.). In spite of the major efforts, coverage in many parts of malaria-endemic SSA is still inadequate and needs to be scaled up (http://malaria.wellcome.ac.uk), an observation that agrees with our result of about 19% of pregnant women that slept under LLIN the night before survey, leaving a gap of about 80% if universal coverage is considered. This is in consonance with another study conducted within the same region that detailed LLIN usage among pregnant women at 19% and documented lack of awareness as a challenge faced by pregnant women in accessing LLINs (Salaudeen et al., 2009). Even where there is awareness, some pregnant women still need the approval of their husbands or other “seniors” or influential people in the hierarchy of general, low co trasts with corre indicating that t coverage and maintenance of challenging.

In summary, w national policies

Table 4. Percent distribution of under-fives and pregnant women who slept or did not sleep under LLINs night before survey relative to geographi

Area Council	Children under the age of 5 years					Pregnant wome	
	Slept under LLIN freq. (%)	Did not sleep under LLIN freq. (%)	χ^2	p	OR (CI)	Slept under LLIN freq. (%)	Did not sleep under LLIN freq. (%)
Urban							
AMAC	0 (0.0)	74 (100.0)	6.7	0.10	0.0 (undefined)	0 (0.0)	31(100.0)
Semiurban							
Kuje	2 (3.2)	60 (96.8)	2.9	0.09	0.29 (0.07-1.30)	3 (13.0)	20 (87.0)
Bwari	4 (6.7)	56 (93.3)	0.3	0.6	0.72 (0.23-2.29)	7 (46.7)	8(53.3)
G/lada	13 (12.3)	93 (87.7)	4.0	0.05	2.70 (0.99-7.95)	5 (41.7)	7(58.3)
Sub-total	19 (8.3)	209 (91.7)	*6.5	0.01	0.0 (undefined)	15 (30.0)	35 (70.0)
Rural							
Abaji	13 (13.7)	82 (86.3)	11.6	0.0007	15.54 (1.99, 121.30)	8 (47.1)	9(52.9)
Kwali	1 (1.0)	98 (99.9)				0 (0.0)	22(100.0)
Sub-total	14 (7.2)	180 (92.8)	**5.6	0.02	undefined	8 (20.5)	31 (79.5)
			***0.18	1.17 (0.57, 2.40)			*
Total	33 (6.7)	463 (93.3)	-	-	-	23 (19.2)	97 (80.8)

*=comparison between urban and semi-urban, **=comparison between urban and rural, ***=comparison between semi-urban and rural.

Table 5. Treatment seeking behaviour of children under 5 years (U5) by location.

Area council	No. of Under-5s	No. with fever in past 2 weeks freq. (%)	Sought treatment Freq. (%)	Did not seek treatment Freq. (%)	χ^2	P	OR
Urban							
AMAC	74	65 (87.8)	63 (96.9)	2 (3.1)	13.2	0.0002	12.3
Semiurban							
Bwari	60	7 (11.7)	3 (42.9)	4 (57.1)			
G/lada	106	14 (13.2)	13 (92.9)	1 (7.1)			-
Kuje	62	11 (17.7)	7 (63.6)	4 (36.4)			
Sub-total	228	32 (14.0)	23 (71.9)	9 (28.1)	17.8	0.00003	27.4
Rural							
Abaji	95	6 (6.3)	5 (83.3)	1 (16.7)			-
Kwali	99	65 (65.7)	65 (100.0)	0 (0.0)			
Sub-total	194	71 (36.6)	70 (98.6)	1 (1.4)	0.43	0.51	0.45

(a) (b)

Figure 5. Some unorthodox uses of treated mosquito nets (Source: http://allafrica.com/stories/201206130598.html).

Table 6. Women in the survey aged 15 to 49 years who took antimalarials medication during pregnancy by geographical location.

Area council	Total No. of pregnant women	Total No. of pregnant women in the survey	Took antimalarial medication Freq. (%)	Did not take antimalarial medication Freq. (%)	Don't know Freq. (%)	χ^2	P
Urban							
AMAC	43, 580	75	58 (77.3)	13(17.3)	4(5.3)	1.97	0.1
Semiurban							
Bwari	8,092	36	23 (63.9)	9 (25.0)	4 (11.1)		
G/lada	9,025	77	41 (57.7)	9 (11.7)	27(35.1)		
Kuje	5,979	43	21 (48.8)	14(32.6)	8 (18.6)		
Sub-total	23,096	156	85 (54.5)	32(20.5)	39(25.0)	0.75	0.3
Rural							
Abaji	2,320	32	25 (78.1)	3(9.4)	4 (12.5)		
Kwali	4,950	78	52 (66.7)	19(24.4)	7(9.0)		
Sub-total	7,270	110	77 (70.0)	22(20.0)	11(10.0)	0.38	0.5
Total	73,946	341	220 (64.5)	67(19.7)	54(15.8)		

Table 7. Distribution of LLINs in FCT between 2007 and 2009.

Distributor	Year of distribution	Quantity distributed
Federal Ministry of Health	2007	20,000
Yakubu Gowon Centre	2008	18,398
Millennium Development Goals, Federal Capital Territory	2008	245,000
Health and Human Services Secretariat, FCT/UNICEF	2009	13,158
Total	2007 – 2009	296,556

malaria in pregnancy, it is clear that, with some notable exceptions, not enough progress has been made towards the new RBM goals or the policy ambitions of each country. With only three years in which to meet the Millennium Development Goals, it is sobering that in countries with a national policy for IPT and/or ITN, a large number of pregnancies remain unprotected by an ITN and by IPTp. Greater effort to fully understand the reasons why coverage is so low and to develop strategies to combat this is urgently needed to protect the tens of millions of pregnancies in sub-Saharan Africa threatened by malaria every year.

By greatly reducing malaria transmission, LLINs decrease the risk of others in the community coming into contact with an infected mosquito. Every LLIN user thereby contributes not only to his or her safety, but also to the safety of others through the mass effect (http://www.givewell.org/international/technical/programs/insecticide-treatednets#). The effect is analogous to herd immunity from vaccines. It makes sense to assume that to have maximum effect within communities, LLIN coverage should be as high as possible, with a target of complete coverage (http://www.malariaconsortium.org/pioneer/pages/what-we-do/long-lastinginsecticidal-nets.). The mass effect works in three ways. First, mass coverage by LLINs reduces the number of infective mosquitoes in the community. Second, mass coverage shortens the lifespan of the mosquitoes, thus reducing the possibility for maturation of *Plasmodium* sporozoites and hence decreasing the proportion of mosquitoes that become infective. Therefore, the possibility of transmitting the illness to others is greatly reduced. Third, with some *Anopheles* species, there is a possibility that mass coverage might divert mosquitoes from human to animal biting, thereby reducing human to human transmission, though this requires further studies.

However, *Anopheles gambiae* is so anthropophilic that, even with nearly 100% coverage with insecticidal nets, about 80% of blood meals were found to come from human beings. Taking together these effects on the vector population can greatly reduce transmission of disease, but only if the coverage of mosquito nets is sufficiently high. Importantly, at low coverage, the mosquitoes that are deflected by the nets will tend to seek out another human being to bite. There would be little or no reduction in overall transmission, but only a diversion. If transmission was diverted from high-risk to low-risk individuals that would be beneficial there would be no major effect on intensity of transmission of malaria in the community. Optimum community protection is achieved when mass coverage with LLINs is combined with universal access for the community to timely and effective treatment in the event of infection. However, a tracking system, as well as a strong community health education should be put in place to monitor LLIN use in the community and avoid wastage and inappropriate use (Brieger, 2012). Timely treatment can also be expected to have a community benefit. By clearing the infection in the patient as soon as possible, the individual is not only cured of the disease but is also no longer a reservoir of parasites for transmission to others.

Limitations

This study has some notable limitations. First, the survey is localized to FCT and the sample size and sampling technique might be inadequate to reflect overall net ownership and usage in FCT or generalized to net ownership and usage in Nigeria. The nets distributed before this survey are unaccounted for since the details of the distributions are unavailable to the authors. We relied on primarily on self-reported information which is subject to deficient recall and social interest bias.

Secondly, an in-depth analysis of access to LLIN was not done since the LLIN was supposed to have been distributed free of charge to women and children below 5 years of age. The type of LLINs prevalent in each geographical area, that is, rectangular or conical, was not accounted for; the cost of each net, if purchased in the open market or given free (transport from home to collection centre and from there back home) was not extracted from households, and the willingness-to-pay for the commodities (LLINs, ACTs, SP) when out of stock was not recorded or calculated. Next, analysis of net use among women of reproductive age was not considered. Recall of use of medicines to prevent malaria during last

pregnancy, an event which could have taken place between two weeks and at least one year prior to the survey is always a challenge. Information on the outcome of the last pregnancy was not retrieved from the women in reproductive age.

Lastly, this survey did not probe further on the types of antimalarials taken by pregnant women or when during their current pregnancy, the antimalarials were taken and on other types of medication, whether orthodox or unorthodox, taken during current pregnancy.

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